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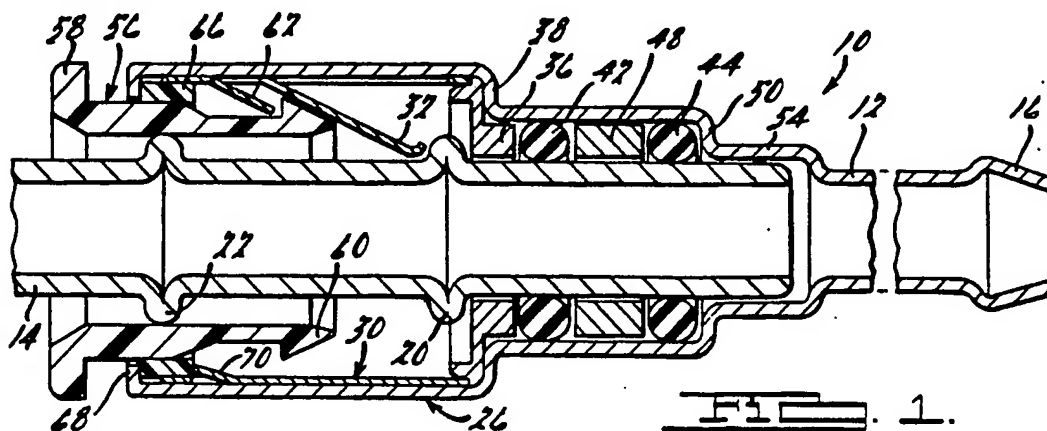
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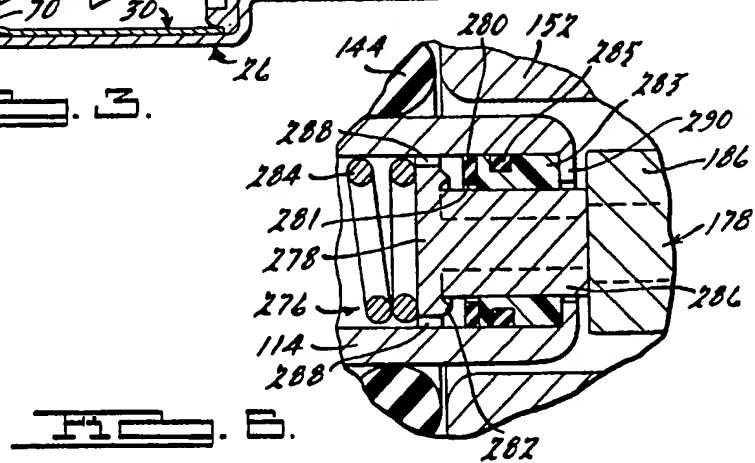
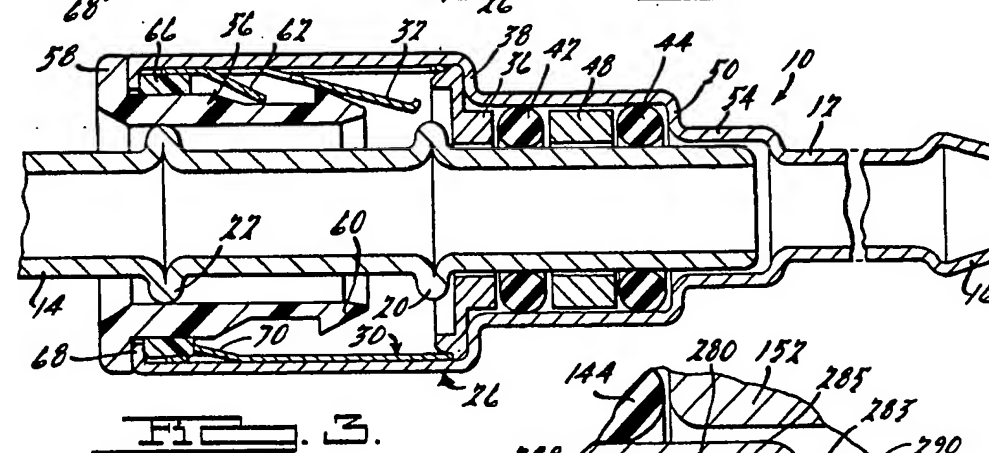
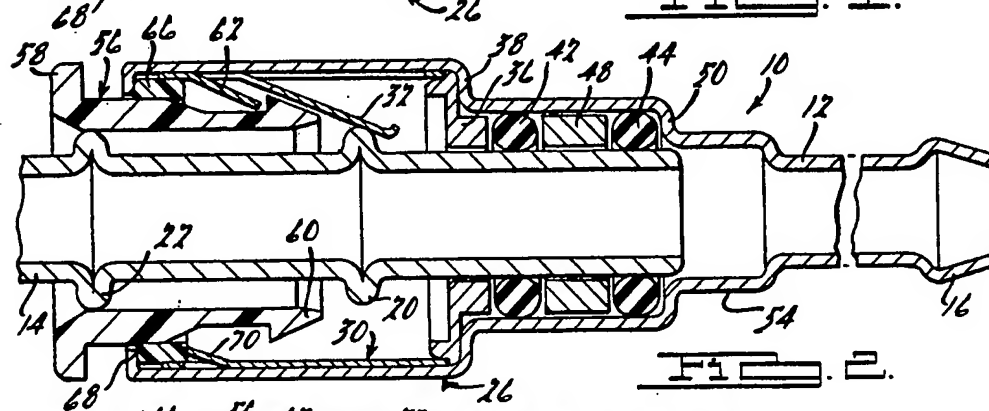
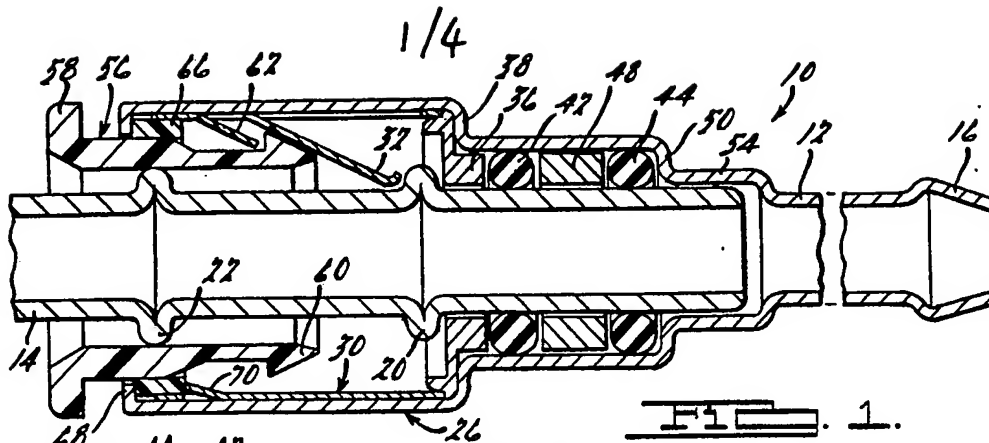
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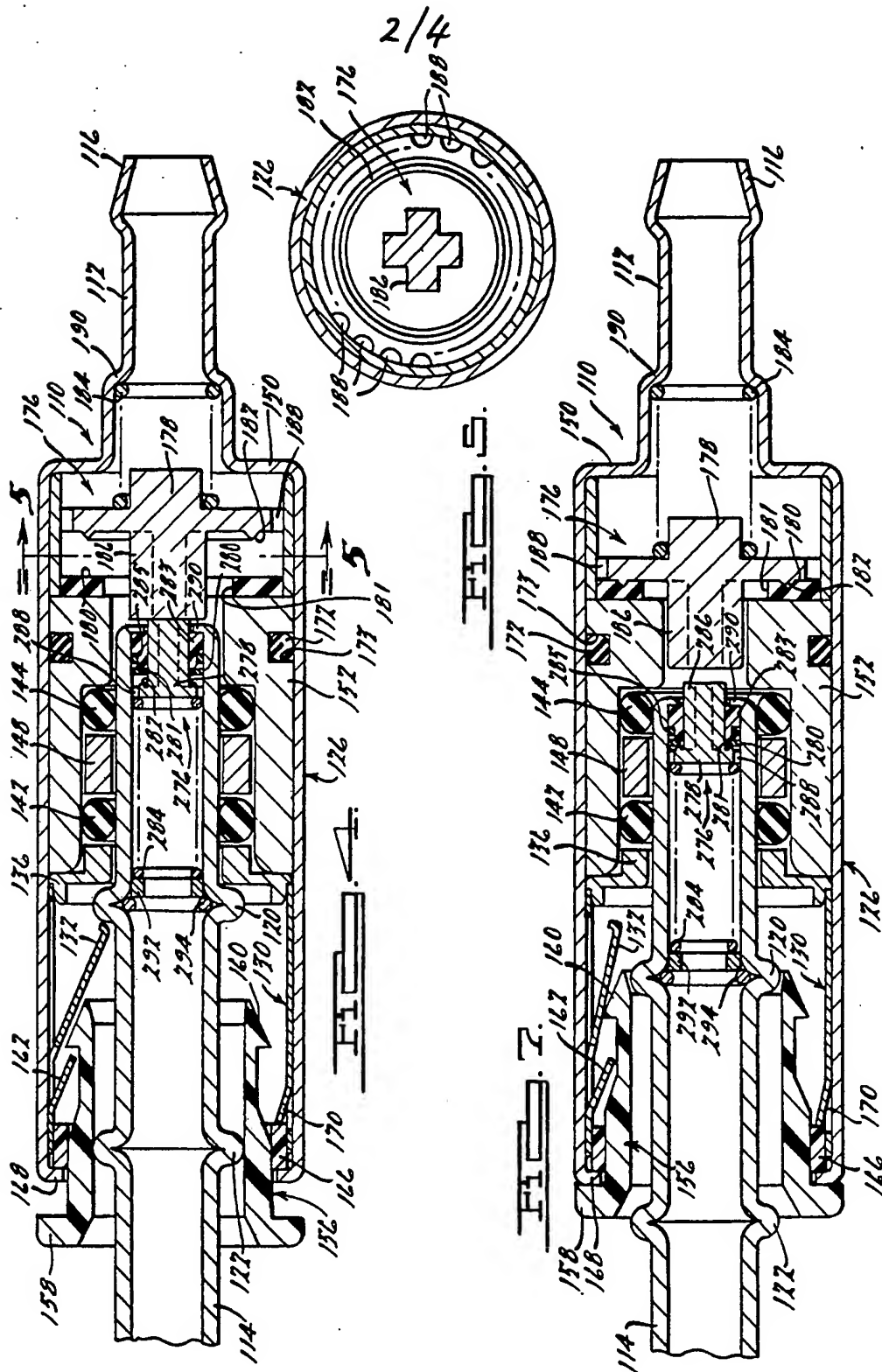
## (54) Quick-connect fluid fitting assembly

(57) A quick-connect fitting or coupling assembly for releasably connecting and disconnecting a pair of fluid conduits 12, 14 in fluid communication with one another includes a socket 26 on one of the fluid conduits for receiving the other fluid conduit inserted longitudinally therein into an interlocking engagement with a resilient barb member 32. A removal member 56 is selectively slidably movable in the socket for deflecting the barb member out of such interlocking engagement in order to remove the previously inserted fluid conduit. The assembly also preferably includes lateral support member 66 for laterally supporting the fluid conduits relative to one another thus strengthening the connection therebetween. One of the preferred embodiments (Fig. 4) includes one of more valve mechanisms for preventing fluid flow into or out of the disconnected fluid conduits, while allowing fluid flow therebetween when the fluid conduits are connected to one another. Other embodiments (Fig. 9) include a feature by which the fitting assembly is relatively tamper-resistant.



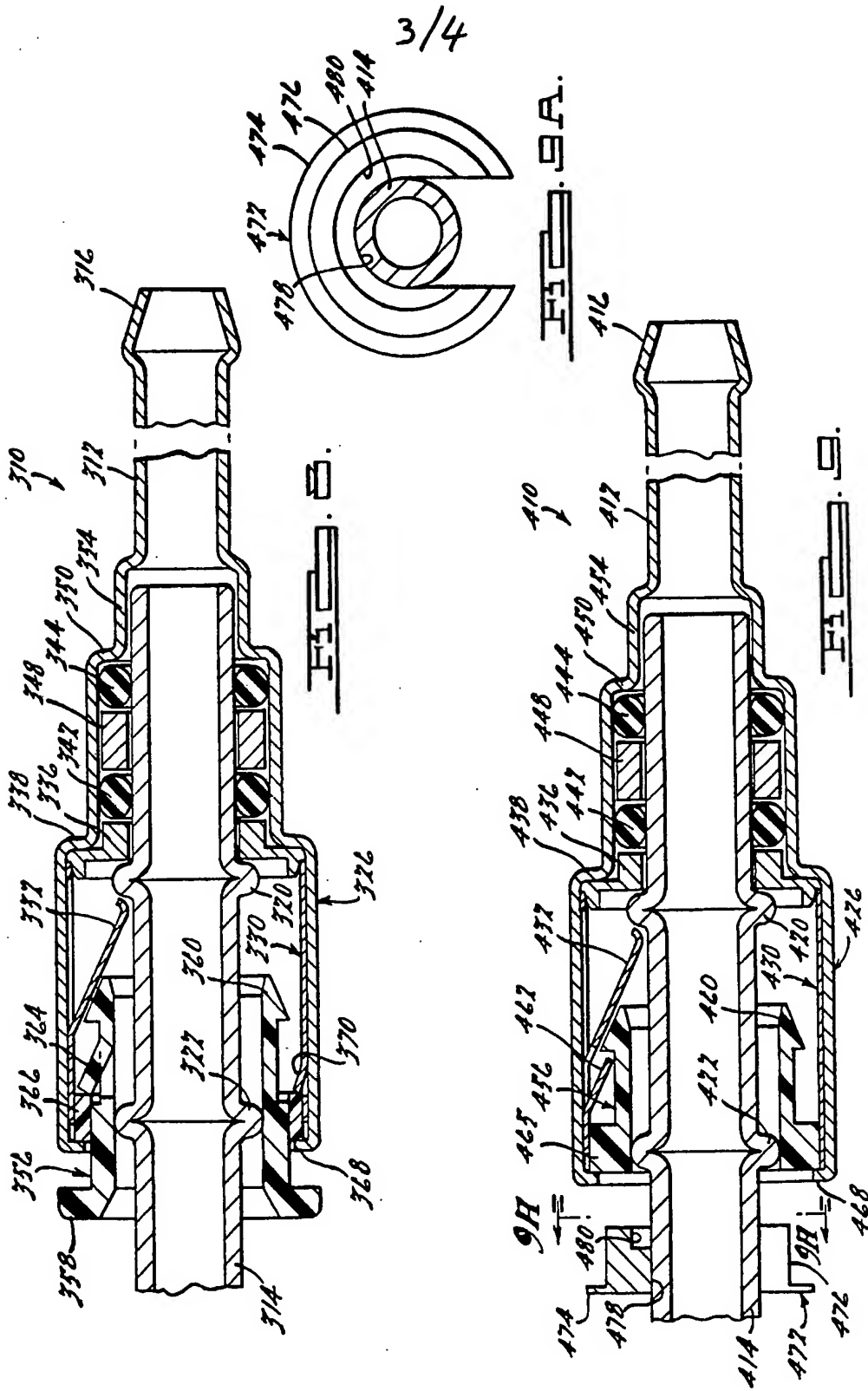
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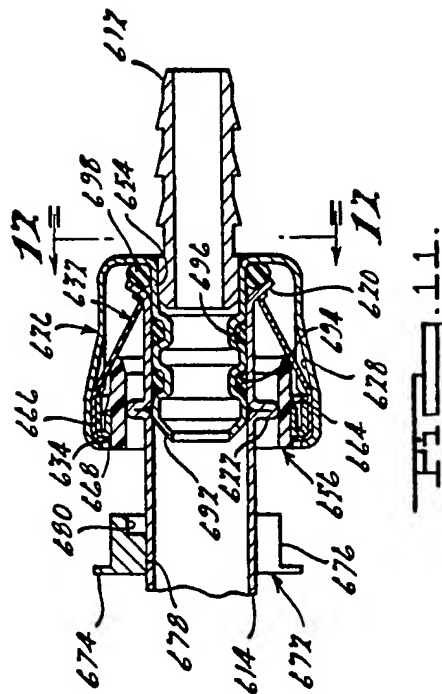
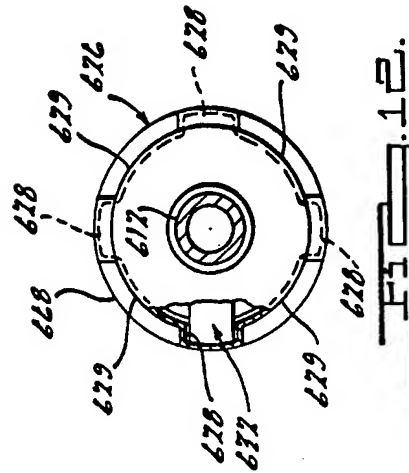
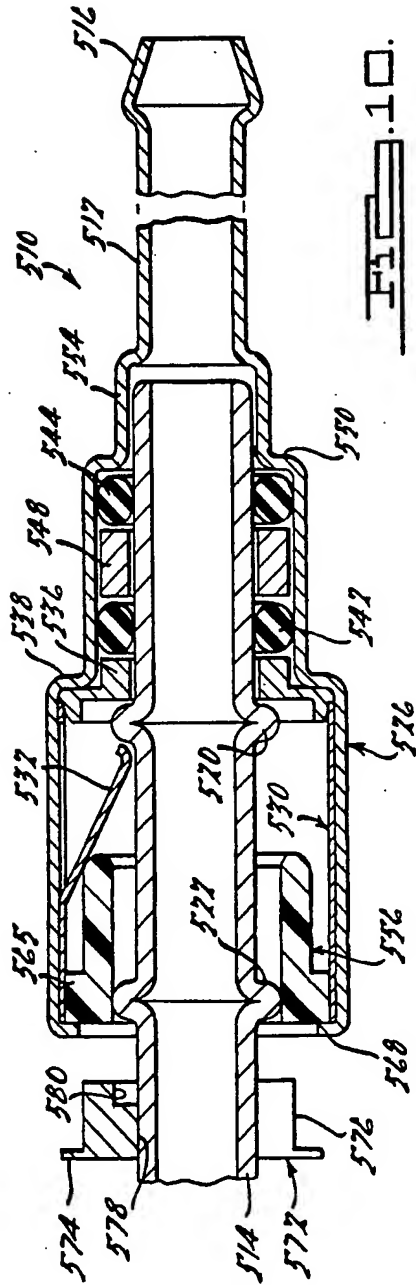
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## SPECIFICATION

## Quick-connect fluid fitting assembly

## 5 BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates generally to fluid conduit fitting or coupling devices. More particularly, the invention relates to fluid conduit fittings or couplings adapted for quickly and conveniently connecting or disconnecting a pair of fluid conduits.

A wide variety of fluid conduit fittings and couplings have been provided in the prior art for connecting fluid conduits in fluid communication with one another. One type of such previously-known couplings includes an external generally U-shaped staple or spring clip that is inserted into generally lateral openings in an assembled fitting or coupling in order to interlockingly connect the components of the assembly to one another. Frequently, however, such staples or clips become misplaced or permanently deformed as a result of repeated assembly and disassembly of the coupling and are therefore rendered unusable and must be replaced. Additionally, such staples or clips frequently protrude outwardly away from the fitting or coupling assembly where they can snag on, or interfere with, other adjacent components in an apparatus or system. Finally, in high pressure applications, such staples or clips are often required to be very stiff and are thus difficult to install and remove from the fluid coupling or fitting.

Other prior art fittings or couplings require the use of an external clamp or ring that compresses one of the fluid conduits onto a nipple-like structure and are very time consuming to install or remove during connection or disconnection of fluid conduits. Like the staples or clips described above, these external clamps or rings often become misplaced, or permanently damaged during assembly and disassembly of the fluid conduit joint and therefore must be frequently replaced.

Still other prior art fitting or coupling assemblies include collars or sleeve-like members that are interlockingly interconnectable and disconnectable with one another in order to sealingly connect or disconnect a pair of fluid conduits. Although such fitting or coupling assemblies overcome many of the disadvantages of the prior art devices described above by having the collars or sleeves retained on the fluid conduits even when disconnected, but frequently do not provide adequate lateral support for the fluid conduits being connected to one another and thereby providing a relatively weak connection that is susceptible to leakage or that can result in physical damage to the conduits.

Still other well-known fitting or coupling assemblies include male and female elements on the conduits that are threadably connectable

to one another, but are cumbersome and time-consuming to connect or disconnect. These types of couplings are also susceptible to leakage, thereby requiring the application of sealing compounds or tape-type sealants to the threads each time the coupling elements are connected to one another. In addition, these types of couplings or fittings, as well as those described above, frequently do not provide a means for preventing leakage from the fluid conduits during connection or disconnection.

Accordingly, it is one of the objects of the present invention to provide an improved fitting or coupling assembly especially adapted for quickly, conveniently, and releasably connecting a pair of fluid conduits in fluid communication with one another.

Another object of the present invention is to provide a quick-connect fitting or coupling assembly that does not include separate or loose components that can be misplaced or damaged during repeated connection and disconnection of a pair of fluid conduits.

Still another objective of the present invention is to provide a quick-connect fluid conduit assembly that provides substantial lateral support for the fluid conduits being connected together in order to prevent damage to the conduits or the fitting and to prevent leakage therebetween once the fitting is assembled.

A further object of one of the preferred embodiments of the present invention is to provide a fluid conduit fitting or coupling assembly that includes one or more valve mechanisms for substantially preventing leakage from the fluid conduits being connected together, both during connection and disconnection of the assembly.

In accordance with the present invention, a quick-connect fitting assembly for releasably connecting a pair of fluid conduits and fluid communication with one another includes a socket on one of the fluid conduits for receiving the other fluid conduit inserted longitudinally inwardly into the socket. The inserted fluid conduit has a generally laterally-extending protuberance thereon, and a retainer within the fluid socket includes a resilient barb member that is resiliently deflectable into a longitudinally interlocking engagement with the protuberance on the inserted fluid conduit. Preferably, a removal member is longitudinally insertable into the socket and selectively movable therein in order to engage and resiliently deflect the barb member laterally out of interlocking engagement with the protuberance on the inserted conduit, thereby allowing the inserted conduit to be withdrawn from the socket. Lateral support is preferably provided both at the outward end of the fitting assembly and at the inner end of the inserted fluid conduit in order to laterally support the inserted fluid conduit relative to the socket and the remainder of the fitting assembly. In a

preferred embodiment, the above-mentioned removal member contributes to such lateral support and also functions as a dust cap for substantially preventing foreign material from entering the socket and inhibiting proper operation of the fitting assembly.

In one preferred embodiment of the invention, the removal member is a generally sleeve-like member extending at least partially into the socket, with a collar member disposed between the socket and the sleeve-like removal member. Such collar member is located at a longitudinal position generally surrounding both the removal member and a second laterally-extending protuberance on the inserted conduit so that the sleeve-like removal member and the collar member laterally support the inserted fluid conduit. In addition, the retainer in such preferred embodiment includes the above-mentioned barb member for interlockingly engaging the first protuberance on the inserted fluid conduit, as well as a second barb member for retaining the removal member within the socket, while allowing the removal member to move laterally inwardly to disengage the first barb member from the inserted fluid conduit. Such preferred retainer also includes a third barb member for retaining the collar member in its proper longitudinal position in the socket.

In still another embodiment of the invention, one or more normally-closed valve means are provided for substantially preventing leakage from one or both of the fluid conduits during disconnection and prior to connection. Such valve means, which can be provided on either or both of the inserted fluid conduit and the socket, are urged into open positions when the inserted fluid conduit is inserted into the socket and are urged to their normally-closed positions when the fitting assembly is disconnected.

In still other embodiments of the invention, the quick-connect fitting assembly includes means for resisting or inhibiting the inadvertent or unauthorized disconnection of the fluid conduits from one another.

Additional objects, advantages and features of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a longitudinal cross-sectional view of one preferred embodiment of a quick-connect fitting assembly according to the present invention.

Figure 2 is a longitudinal cross-sectional view similar to Fig. 1, but showing one of the fluid conduits being inserted into the fitting assembly.

Figure 3 is a longitudinal cross-sectional view similar to Figs. 1 and 2, but showing the previously inserted fluid conduit being with-

drawn from the fitting assembly.

Figure 4 is a longitudinal cross-sectional view of another preferred embodiment of the present invention, wherein a quick-connect fitting assembly includes valving mechanisms for substantially preventing leakage from the fluid conduits during connection or disconnection.

Figure 5 is a cross-sectional view taken generally along line 5-5 of Fig. 4.

Figure 6 is an enlarged cross-sectional view of one of the valve elements of Fig. 4.

Figure 7 is a longitudinal cross-sectional view similar to that of Fig. 4, but illustrating the previously inserted fluid conduit being withdrawn from the fitting assembly.

Figure 8 is a longitudinal cross-sectional view similar to Fig. 1, but illustrating an alternate embodiment of the present invention.

Figure 9 is a longitudinal cross-sectional view similar to Fig. 1, but illustrating another alternate embodiment of the present invention wherein the quick-connect fitting assembly is relatively tamper-resistant, thereby inhibiting the improper disconnection thereof.

Figure 9A is a lateral cross-sectional view taken generally along line 9A-9A of Fig. 9.

Figure 10 is a longitudinal cross-sectional view similar to Fig. 9, but illustrating still another relatively tamper-resistant embodiment of the present invention.

Figure 11 is a longitudinal cross-sectional view of still another alternate embodiment of the present invention.

Figure 12 is a lateral cross-sectional view taken generally along line 12-12 of Fig. 11, but shown with a portion of the socket member broken away to reveal internal shape and components.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figs. 1 through 12 illustrate various exemplary embodiments of the present invention in quick-connect fitting assemblies for releasably connecting pairs of cylindrical fluid conduits to one another in fluid communication therebetween. As will become apparent to one skilled in the art from the following discussion, the illustrated embodiments of the quick-connect fitting assembly according to the present invention are also applicable to fluid systems and fluid conduits of shapes, configurations or types other than those shown for purposes of illustration in the drawings.

Referring to Figs. 1 through 3, a preferred quick-connect fitting assembly 10 is provided in accordance with the present invention for releasably connecting a first fluid conduit 12 and a second fluid conduit 14 to one another in fluid communication therebetween. It should be noted that the first fluid conduit 12, shown for purposes of illustration, includes a nipple portion 16 thereon and is adapted for connection to a flexible fluid tube or other conduit. It should be emphasized, however, that such a



construction is shown merely for purposes of illustration, and the present invention is equally applicable to a first fluid conduit of virtually any other known construction, either rigid or flexible, and with or without such fluid conduit being adapted for connection to another conduit.

The second fluid conduit 14, which preferably includes first and second generally laterally-extending protuberances 20 and 22, is longitudinally insertable into a socket member or assembly 26 that is either integrally formed on the first fluid conduit 12 or sealingly secured thereto. The socket member or assembly 26 includes a preferred resilient or spring-like retainer member 30 disposed therein and having a first barb member 32 extending inwardly therefrom in a generally longitudinal and lateral direction.

When the second fluid conduit 14 is longitudinally inserted into the socket member 26 as shown in Fig. 2, the first protuberance 20 engages the first barb member 32, and causes it to resiliently deflect in a generally outward direction as the first protuberance 20 passes longitudinally thereby. Once the first protuberance 20 has longitudinally cleared the first barb member 32, the first barb member 32 resiliently retracts inwardly into a longitudinally interlocking engagement with the first protuberance 20. Thus, in its fully inserted position, the first protuberance 20 on the second fluid conduit 14 is longitudinally restrained between the first barb member 32 and a stop member 36 disposed in a retaining and abutting engagement with a stepped portion 38 of the socket member 26. One or more sealing members, such as sealing members 42 and 44, are sealingly compressed between the inner surface of the socket member 26 and the outer surface of the second fluid conduit 14 in order to provide fluid sealing between the first and second fluid conduits 12 and 14, respectively. Preferably, the sealing members 42 and 44, are separated and maintained in their proper positions by an inner collar member 48 and are longitudinally retained within the socket member 26 between the stop member 36 and a stepped portion 50 of the socket member 26. A reduced diameter portion 54 of the socket member 26 provides lateral support for the second fluid conduit 14 at a longitudinal position generally adjacent its inner end, thereby strengthening the interconnection therebetween. Although such inner and lateral support is provided primarily by the reduced diameter portion 54, the inner collar member 48 also contributes somewhat to the lateral support of the second fluid conduit 14.

The fitting assembly 10 also includes a removal member 56, which is generally of a sleeve-like configuration and extends at least partially into the socket member 26. The removal member 56 is longitudinally movable in an inward direction to engage and urge the

first barb member 32 into a resiliently and outwardly deflected position where it is clear of the first protuberance 20 on the second fluid conduit 14. When the first barb member 32 is resiliently deflected into such a position as shown in Fig. 3, the second fluid conduit 14 can be longitudinally withdrawn from the socket member 26, thereby disconnecting the first fluid conduit 12 and the second fluid conduit 14 from one another.

The removal member 56 preferably includes a flange portion 58 at its longitudinally outer end that limits the longitudinally inward movement of the removal member 56 and provides an external bearing surface that is abutable by the user's hand or by a tool for selectively urging the removal member 56 in a longitudinally inward direction in order to remove the second fluid conduit 14 from the socket member 26. The removal member 56 also preferably includes a generally laterally-extending discontinuity 60 that is engaged by a second barb member 62 on the retainer member 30 for restraining or limiting the longitudinally outward movement of the removal member 56, while still allowing it to be moved longitudinally inwardly in order to engage the first barb member 32. In this regard, it should be noted that the discontinuity 60 on the removal member 56 preferably has a sloped inner end that is generally adjacent the first barb member 32 when the fitting assembly 10 is in its assembled or connected condition and therefore provides longitudinal support for the first barb member 32 in order to aid in resisting any longitudinally outward movement of the second fluid conduit 14 relative to the socket member 26. Furthermore, when the removal member 56 is moved longitudinally inwardly to engage and resiliently deflect the first barb member 32 and then released, the first barb member 32 resiliently biases the removal member 56 back to its normal longitudinal position within the socket member 26.

The socket member or assembly 26 also preferably includes an outer collar member 66 disposed generally adjacent its longitudinally outward end and retained therein between a socket flange portion 68 and a third barb member 70 that extends generally in a longitudinally outward and laterally inward direction to retainingly engage the outer collar member 66. The outer collar member 66 is positioned laterally between the removal member 56 and the socket member 26 at a longitudinal position wherein it generally surrounds the second protuberance 22 on the second fluid conduit 14 so that the outer collar member 66 and the removal member 56 provide lateral support for the second fluid conduit 14 generally at or near the longitudinally outer end of the socket member 26. This lateral support, coupled with the lateral support provided by the reduced diameter portion 54 at the opposite longitudinal end of the socket member 26,

provide improved strength and stability of the connection between the first and second fluid conduits 12 and 14, respectively, over that provided by prior art quick-connect fitting assemblies. Such strength and stability also contribute greatly to substantially preventing leakage between the first and second fluid conduits 12 and 14, respectively.

In addition to the above-discussed lateral support provided at the longitudinally outer end of the socket member 26 by the outer collar member 66, the removal member 56, and the second protuberance 22, the engagement between the interior surface of the removal member 56 and the second protuberance 22, as well as the engagement between the outer surface of the removal member 56 and the socket flange 68, allow the removal member 56 to serve as a "dust cap" that substantially prevents the entry of dust or other foreign material into the socket member 26. Thus, the preferred removal member 56 serves at least three functions, namely the conduit removal and lateral support functions described above, as well as substantially preventing the entry of such foreign material.

During initial assembly of the quick-connect fitting assembly 10, the sealing members 42 and 44 and the inner collar member 48 are first inserted into the socket member 26 and retained therein by the stop member 36. Next, the retainer member 30, which can be stamped out of sheet spring material, for example, is inserted into the socket member 26 in a longitudinal and lateral engagement with the stop member 36. The outer collar member 66 is then inserted into the socket member 26 adjacent the third barb member 70, and the socket flange 68 is swaged, spun, or otherwise formed into a laterally inwardly-extending configuration in order to retain the outer collar member 66 and the retainer member 30 within the socket member 26.

After the above-described assembly of the socket member 26 and related components is completed, the removal member 56 is inserted longitudinally into the socket member 26, wherein the discontinuity 60 engages and resiliently deflects the second barb member 62 laterally outwardly until the discontinuity 60 passes longitudinally thereby. The second barb member 62 then resiliently retracts into the above-described longitudinal engagement with the discontinuity 60 on the removal member 56. At this point in the assembly operation, the quick-connect fitting assembly 10 is ready for insertion of the second fluid conduit 14 and for subsequent connection or disconnection of the first and second fluid conduits 12 and 14, respectively.

Figs. 4 through 7 illustrate another of the preferred embodiments of the present invention, in which a quick-connect fitting assembly 110 is similar in many respects to quick-con-

nect fitting assembly 10 of Figs. 1 through 3, except that the preferred fitting assembly 110 includes valve assemblies 176 and 276 and an inner sleeve 152 for laterally supporting the second fluid conduit 114 generally adjacent its inner end. Because of the many similarities in both configuration and function between the fitting assembly 110 of Figs. 4 through 7 and the fitting assembly 10 of Figs. 1 through 3, various elements of the fitting assembly 110 that are similar in configuration or function to those of the fitting assembly 10 are indicated by reference numerals that are 100 numerals higher than the corresponding elements of the fitting assembly 10. Also because of the many similarities in both configuration and function between the fitting assembly 10 and the fitting assembly 110, the description of such similar or corresponding elements or features is not repeated herein in connection with the fitting assembly 110.

In the preferred quick-connect fitting assembly 110 illustrated in Figs. 4 through 7, the socket member 126 includes the valve assembly 176 therein, which is a normally-closed valve mechanism for preventing fluid flow into or out of the first fluid conduit 112. The valve assembly 176 includes a valve member 178 that is longitudinally movable between an open position (shown in Fig. 4) spaced longitudinally away from a valve seat 180, and a closed position (shown in Fig. 7) wherein the valve member 178 is in sealing engagement with the valve seat 180.

When the valve member 178 is in its open position as shown in Fig. 4, fluid communication is provided between the interior of the socket member 126 and the first fluid conduit 112, by way of an aperture 181 extending through the valve seat 180 and a plurality of openings 188 in the valve member 178 (see Fig. 5). The valve member 178 is resiliently biased toward its closed position by a spring 184 that is compressed between the valve member 178 and a stepped portion 190 of the first fluid conduit 112. The valve member 178 also includes an actuating rod 186 extending in a generally longitudinal direction through the aperture 181 in the valve seat 180 and having a cross-sectional shape that allows fluid flow through the aperture 181 when the valve member 178 is in its open position. The valve member 178 also preferably includes an annular ridge portion 182 for sealingly engaging the valve seat 180.

Preferably, the valve seat 180 is an annular disc-shaped member composed of an elastomer or other suitable valve seat material. In such preferred embodiment, the valve seat 180 is supported and retained in its proper position within the socket member 126 by the inner sleeve 152, which is in turn held in its proper longitudinal position within the socket member 126 by the stop member 136 and the retainer member 130. An O-ring or other

suitable sealing member is preferably provided in a groove 173 in the inner sleeve 152 in order to prevent leakage from the first fluid conduit 112 into the remainder of the socket member 126.

The second fluid conduit 114 also includes a valve assembly 276, which is similar in many respects to the valve assembly 176 in the socket member 126. The valve assembly 276 includes a valve member 278, which is longitudinally movable between a closed position in sealing engagement with a valve seat 280 (as shown in Fig. 7) and an open position spaced longitudinally away from the valve seat 280 (as shown in Fig. 4). Like the valve seat 180, the valve seat 280 is preferably an annular disc-shaped member composed of an elastomeric material or other suitable sealing material, and has an aperture 281 extending therethrough to allow fluid flow into or out of the second fluid conduit 114 when the valve member 278 is in its open position. It should be noted that the valve member 278 is preferably substantially identical in configuration to the valve member 178, but is smaller so that it can fit within the second fluid conduit 114.

The valve seat 280 is retained within the second fluid conduit 114, generally adjacent an end portion thereof, by a backing ring 283, which is sealed with respect to the interior of the second fluid conduit 114 by a sealing member 285. The valve seat 280 and the backing ring 283 are retained within the second fluid conduit 114 by a laterally inwardly-extending flange portion 290. Similar to the valve member 178, the valve member 278 includes a plurality of flow openings 288 extending therethrough, as well as an actuating rod 286 extending longitudinally through the aperture 281 of the valve seat 280. As was discussed above in connection with the actuating rod 186, the actuating rod 286 has a cross-sectional shape and configuration that allows fluid flow thereby when the valve member 278 is in its open position. A biasing spring 284 is provided within the second fluid conduit 114 for resiliently biasing the valve member 278 toward its closed position, and is preferably retained within the second fluid conduit 114 by way of one or more retainer or snap rings, such as those indicated by reference numerals 292 and 294.

When the second fluid conduit 114 is longitudinally inserted into the socket member 126, the actuating rods 186 and 286, which extend longitudinally in opposite directions, abuttingly engage one another in order to urge their respective valve members 178 and 278 into their open positions. Thus, when the first and second fluid conduits 112 and 114 are connected together in the quick-connect fitting assembly 110 as shown in Fig. 4, the respective valve assemblies 176 and 276 are opened in order to provide fluid communication between the first and second fluid con-

duits 112 and 114, respectively. It should be noted, however, that prior to such insertion of the second fluid conduit 114, the valve assemblies 176 and 276 are in their normally-closed condition, thereby substantially preventing leakage from the first fluid conduit 112 and the second fluid conduit 114, respectively.

In order to substantially prevent appreciable leakage from the first and second fluid conduits 112 and 114, respectively, when they are releasably disconnected, the biasing springs 184 and 284 longitudinally urge their respective valve members 178 and 278 into their closed positions as the second fluid conduit 114 is longitudinally withdrawn from the socket member 126. Preferably, the longitudinal travel of the valve members 178 and 278 in their closing directions is less than the distance between at least one of the sealing members 142 and 144 and the end of the second fluid conduit 114 when the second fluid conduit 114 is fully inserted into the socket member 126. By such an arrangement, the fluid seal between the second fluid conduit 114 and the socket member 126 (by way of sealing members 142 and 144) is preserved during withdrawal of the second fluid conduit 114 until after the valve members 178 and 278 have moved into their closed positions. Thus, when the second fluid conduit 114 is removed from the socket member 126, at most only a small and relatively negligible amount of fluid between the sealing member 144 and the valve seat disc 180 is allowed to escape. This arrangement, therefore, allows the quick-connect fitting assembly 110 to be used in fluid systems where it is necessary or desirable to substantially prevent or minimize the amount of leakage or pressure loss from the fluid conduits during connection or disconnection, or in fluid systems wherein such connection or disconnection must be performed while the fluid conduits are pressurized and/or contain fluid.

Figs. 8 through 12 illustrate other embodiments of the present invention in which alternate removal members are shown in a quick-connect fitting assembly generally similar to that of Figs. 1 through 3. It should be noted, however, that the structural variations and the inventive principles shown in Figs. 8 through 12 are equally applicable to the embodiments of the invention shown in Figs. 4 through 7.

Because of the many similarities in both configuration and function between the embodiments shown in Figs. 8 through 12 and that of Figs. 1 through 3, various elements in Figs. 8 through 12 that are similar in configuration or function to those of Figs. 1 through 3 are indicated by reference numerals that are 300 numerals higher in Fig. 8, 400 numerals higher in Fig. 9, 500 numerals higher in Fig. 10, and 600 numerals higher in Figs. 11 and 12, than the corresponding elements of the

quick-connect fitting assembly 110 of Figs. 1 through 3. Also because of the many similarities in both configuration and function between the fitting assemblies of Figs. 8 through 12 and the fitting assembly 110 of Figs. 1 through 3, the description of such similar or corresponding elements or features is not repeated in connection with Figs. 8 through 12.

In Fig. 8, a quick-connect fitting assembly 310 includes a retainer member 330 that is generally similar to the retainer member 30 in Figs. 1 through 3, except that the second barb member 62 is deleted therefrom. In place of the second barb member 62 on the socket member 326, the removal member 356 is provided with a resilient removal barb member 364 which is stamped or cut out of the removal member 356 (or otherwise formed thereon). The barb member 364 protrudes in a generally laterally and longitudinally outward direction such that when the removal member 356 is inserted into the socket member 326, the barb member 364 resiliently deflects generally laterally outwardly to longitudinally engage the outer collar member 366 associated with the socket member 326 and interlockingly retain the removal member in the socket member 326. The barb member 364 also restrains or limits the longitudinally outward movement of the removal member 356, while still allowing it to be moved longitudinally inwardly in order to engage and deflect the first barb member 332 as described above in connection with Figs. 1 through 3. It should be noted that the outer collar member 366 can optionally be deleted from the socket member 326, and the barb member 332 can be positioned on the removal member so as to engage the socket flange 368.

In the embodiment illustrated in Fig. 9, a quick-connect fitting assembly 410 includes a retainer member 430 that is generally similar to the retainer member 30 in Figs. 1 through 3, except that the third barb member 70 is deleted therefrom. In addition, the removal member 456 is contained wholly within the socket member 426 thus making the fitting assembly 410 relatively tamper-resistant in order to inhibit the inadvertent or unauthorized disconnection of the first and second fluid conduits 412 and 414, respectively, from one another.

Instead of the outer collar member 66 shown in Figs. 1 through 3, the removal member 456 of Fig. 9 includes an enlarged flange member 465 that extends laterally between the retainer member 430 and thus provides lateral support between the second protuberance 422 on the second fluid conduit 414 and the socket member 426. During initial assembly of the fitting assembly 410, the removal member 456 is inserted into the socket member 426 and the outer end thereof is spun, swaged, or otherwise formed laterally inwardly to form the socket flange 468 for

retaining the removal member 456 and restraining or limiting its longitudinal outward movement within the socket member 426.

When it is desired to disconnect the first and second fluid conduits 412 and 414, respectively, in Fig. 9, a generally U-shaped disconnect tool 472 (shown in Figs. 9 and 9A) is preferably slipped over the second fluid conduit 414 and is slidably moved inwardly to abuttingly engage and urge the removal tool 456 longitudinally inwardly in order to engage and deflect the first barb member 432 as described above in connection with Figs. 1 through 3. As shown in Fig. 9A, the disconnect tool 472 includes an outer flange 474 that is abutable by the user's hand or another tool, a cylindrical portion 476, a generally U-shaped opening 478, and a longitudinal recess 480. The longitudinal recess provides clearance for the second protuberance 422 when the disconnect tool 472 is urged longitudinally inwardly. Alternatively, a screw driver or other suitable common tool or device may be inserted into the socket member 426 to urge the removal member 456 laterally inwardly.

Fig. 10 illustrates a quick-connect assembly 510 that is similar to the quick-connect assembly 410 of Fig. 9, except that the second barb member 462 is deleted in the retainer member 530. In addition, the discontinuity 460 is deleted from the removal member 556 and is replaced by a radiused inner end portion for engaging and deflecting the first barb member 532 as described above. In other respects, the fitting assembly 510 is similar in function and configuration to fitting assembly 410, and the disconnect tool 572 is similar to the disconnect tool 472 of Figs. 9 and 9A. The elements of disconnect tools 472 and 572 are therefore numbered correspondingly.

Figs. 11 and 12 illustrate still another alternate quick-connect fitting assembly 610, which is generally somewhat similar in function to the fitting assemblies 410 and 510 of Figs. 9 and 10, but varies somewhat therefrom in configuration. The socket member or assembly 626 in Figs. 11 and 12 includes an inner portion 692 generally concentrically disposed therein. The inner portion 692 is received within the second fluid conduit 614, with sealing members 694 and 696 therebetween, when it is inserted into the socket member 626 to provide fluid communication with the first fluid conduit 612, which is brazed, soldered, or otherwise secured to the socket member 626. Alternatively the first fluid conduit 612 can be integrally formed with the socket member 626.

The second fluid conduit 614 in Figs. 11 and 12 includes a first protuberance 620 that is preferably flared laterally outwardly and laterally inwardly and that is further sealed with respect to the socket member 626 by sealing member 698. A number of circumferentially spaced, separate and independent leaf

springs or resilient barb members 632 extend laterally and longitudinally inwardly from the interior of the socket member 626. These barb members 632 longitudinally interlockingly engage the first protuberance 620 and retain the second fluid conduit 614 within the socket member 626 in a manner similar to that of the first barb members on the retainer members discussed above in connection with the other embodiments of the invention.

The barb members 632 of the fitting assembly 610 shown in Figs. 11 and 12 are received within internal slots 628 in the socket member or assembly 626, and the socket member or assembly 626 includes a collar member 666 for retaining the barb members 632 in the internal slots 628. The slots 628 are formed in the socket member 626 between intermediate portions 629, which are swaged, pressed, or otherwise formed laterally inwardly in the socket member 626. Preferably, the collar member 666 includes an inner portion that is somewhat resilient in the lateral direction so that it resiliently engages an annular ridge or barb member 664 formed on the removal member 656 when it is inserted into the socket member 626. Thus, the collar member 666 restrains or limits the longitudinal outward movement of the removal member 656 within the socket member 626 in a manner similar to that described above in connection with the other embodiments of the invention.

In Figs. 11 and 12, the second fluid conduits 614 is laterally supported relative to the socket member 626 along virtually the full longitudinal length of the inner portion 692, and by way of the second protuberance 622, the removal member 656, and the collar member 666. In other respects, the fitting assembly 610 functions similar to the other embodiments of the invention described above, and preferably includes the tamper-resistant feature and disconnect tool 672 described above in connection with Figs. 9 through 10.

The foregoing discussion discloses and described exemplary embodiments of the present invention. One skilled in the art will readily recognize from such discussion that various changes, modifications and variations may be made therein without departing from the spirit and scope of the invention as defined in the following claims.

## 55 CLAIMS

1. A quick-connect fitting assembly for releasably connecting a pair of fluid conduits to one another for fluid communication therebetween, said quick-connect fitting assembly comprising:

socket means on a first of the fluid conduits for receiving a second of said fluid conduits inserted longitudinally inwardly into said socket means, said second fluid conduit having a laterally-extending protuberance

thereon;

retainer means for releasably retaining said second fluid conduit within said socket means, said retainer means including a barb member disposed within said socket means and being resiliently deflectable into a longitudinally interlocking engagement with said protuberance as said second fluid conduit is inserted into said socket means;

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removal means longitudinally insertable into said socket means and being selectively movable therein to urge said barb member out of said interlocking engagement with said protuberance; and

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lateral support means for laterally supporting said second fluid conduit relative to said socket means at a longitudinal position outward of said barb member.

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2. A quick-connect fitting assembly according to claim 1, further comprising means associated with said removal means for substantially preventing foreign material from entering said socket means when said second fluid conduit is inserted into said socket means.

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3. A quick-connect fitting assembly according to claim 1, wherein said lateral support means includes a second protuberance on said second fluid conduit extending laterally outwardly in a laterally supporting engagement with said removal means.

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4. A quick-connect fitting assembly according to claim 3, wherein said lateral support means further includes a collar member in said socket means, said collar member being disposed between said removal means and the remainder of said socket means at a longitudinal location generally surrounding said second protuberance with said removal means therebetween.

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5. A quick-connect fitting assembly according to claim 4, further comprising a second barb member within said socket means in a longitudinally interlocking engagement with said collar member.

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6. A quick-connect fitting assembly according to claim 3, wherein said removal means includes a sleeve member disposed between said second protuberance and said socket means, said sleeve member being slidably movable longitudinally on said second fluid conduit into engagement with said barb member.

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7. A quick-connect fitting assembly according to claim 1, further comprising a second barb member within said socket means resiliently deflectable into a longitudinally interlocking engagement with said removal means in order to retain said removal means in said socket means when said removal means is inserted therein.

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8. A quick-connect fitting assembly according to claim 1, further comprising normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said valve

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means when said second fluid conduit is inserted into said socket means.

9. A quick-connect fitting assembly according to claim 1, further comprising normally-closed valve means disposed within said socket means for sealingly closing off said first fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.
10. A quick-connect fitting assembly according to claim 9, further comprising second normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said second valve means when said second fluid conduit is inserted into said socket means.
11. A quick-connect fitting assembly according to claim 1, further comprising second lateral support means for laterally supporting said second fluid conduit relative to said socket means generally adjacent the longitudinally inner end of said second fluid conduit.
12. A quick-connect fitting assembly according to claim 11, wherein said second lateral support means comprises a reduced diameter portion of said socket means surrounding and laterally engaging said longitudinally inner end of said second fluid conduit.
13. A quick-connect fitting assembly for releasably connecting a pair of fluid conduits to one another for fluid communication therebetween, said quick-connect fitting assembly comprising:
- socket means on a first of the fluid conduits for receiving a second of said fluid conduits inserted longitudinally inwardly into said socket means, said second fluid conduit having a laterally-extending protuberance thereon;
  - a first barb member disposed within said socket means and being resiliently deflectable into a longitudinally interlocking engagement with said protuberance as said second fluid conduit is inserted into said socket means;
  - a sleeve member insertable into said socket means between said socket means and said second fluid conduit at a longitudinal position outward of said first barb member and having a discontinuity thereon;
  - a second barb member disposed within said socket means, said second barb member being resiliently deflectable into a longitudinally interlocking engagement with said discontinuity on said sleeve member as said sleeve member is inserted into said socket means;
  - a collar member disposed between said sleeve member and said socket means for laterally supporting said second fluid conduit at a longitudinal position outward of said second barb member; and
  - a third barb member disposed within said socket means in a longitudinally interlocking engagement with said collar member.

14. A quick-connect fitting assembly according to claim 13, wherein said sleeve member is insertable into said socket member to a longitudinal position generally adjacent said first barb member in order to provide longitudinal support therefor resisting longitudinally outward movement of said second fluid conduit, said second barb member resisting longitudinally outward movement of said sleeve member.
15. A quick-connect fitting assembly according to claim 13, wherein said sleeve member is selectively movable in a longitudinally forward direction within said socket means in order to urge said first barb member out of said interlocking engagement with said protuberance and allow said second fluid conduit to be withdrawn from said socket means.
16. A quick-connect fitting assembly according to claim 13, further comprising lateral support means for laterally supporting said second fluid conduit relative to said socket means at a longitudinally outward end of said socket means.
17. A quick-connect fitting assembly according to claim 16, wherein said lateral support means includes a second protuberance on said second fluid conduit extending laterally outwardly in a supporting engagement with said sleeve member.
18. A quick-connect fitting assembly according to claim 13, further comprising normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.
19. A quick-connect fitting assembly according to claim 13, further comprising normally-closed valve means disposed within said socket means for sealingly closing off said first fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.
20. A quick-connect fitting assembly according to claim 19, further comprising second normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said second valve means when said second fluid conduit is inserted into said socket means.
21. A quick-connect fitting assembly according to claim 13, further comprising a resilient retainer member disposed within said socket means and generally surrounding at least a portion of said sleeve member and said second fluid conduit; said resilient retainer member having said first, second and third barb members extending generally in a laterally inward direction therefrom.
22. A quick-connect fitting assembly according to claim 16, further comprising second lateral support means for laterally supporting said second fluid conduit relative to

said socket means generally adjacent the longitudinally inner end of said second fluid conduit.

23. A quick-connect fitting assembly according to claim 22, wherein said second lateral support means comprises a reduced diameter portion of said socket means surrounding and laterally engaging said longitudinally inner end of said second fluid conduit.

24. A quick-connect fitting assembly for releasably connecting a pair of fluid conduits to one another for fluid communication therebetween, said quick-connect fitting assembly comprising:

socket means on a first of the fluid conduits for receiving a second of said fluid conduits inserted longitudinally inwardly into said socket means, said second fluid conduit having a laterally-extending protuberance thereon;

a first barb member disposed within said socket means and being resiliently deflectable into a longitudinally interlocking engagement with said protuberance as said second fluid conduit is inserted into said socket means;

removal means longitudinally insertable into said socket means between said socket means and said second fluid conduit, said removal means having a discontinuity thereon and being longitudinally movable therein to urge said first barb member out of said interlocking engagement with said protuberance;

a second barb member disposed within said socket means, said second barb member being resiliently deflectable into a longitudinal engagement with said discontinuity on said removal means as said removal means is inserted into said socket means, said longitudinal engagement retaining said removal means within said socket means but allowing said longitudinal movement therein; said socket means further including a collar member disposed between said removal means and the remainder of said socket means for laterally supporting said second fluid conduit at a longitudinal position outward of said second barb member; and a third barb member disposed within said socket means in a longitudinally interlocking engagement within said collar member.

25. A quick-connect fitting assembly according to claim 24, further comprising means associated with said removal means for substantially preventing foreign material from entering said socket means when said second fluid conduit is inserted into said socket means.

26. A quick-connect fitting assembly according to claim 24, further including a second protuberance on said second fluid conduit extending laterally outwardly in a supporting engagement with said removal means.

27. A quick-connect fitting assembly ac-

cording to claim 26, wherein said collar member is disposed between said removal means and the remainder of said socket means at a longitudinal location generally surrounding said second protuberance with said removal means therebetween.

28. A quick-connect fitting assembly according to claim 27, wherein said removal means includes a sleeve member between said second protuberance and said socket means, said sleeve member being slidably movable longitudinally on said second fluid conduit into engagement with said first barb member.

29. A quick-connect fitting assembly according to claim 26, wherein said sleeve member is insertable into said socket member to a longitudinal position generally adjacent said first barb member in order to provide longitudinal support therefor resisting longitudinally outward movement of said second fluid conduit, said second barb member resisting longitudinally outward movement of said sleeve member.

30. A quick-connect fitting assembly according to claim 24, further comprising normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.

31. A quick-connect fitting assembly according to claim 24, further comprising normally-closed valve means disposed within said socket means for sealingly closing off said first fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.

32. A quick-connect fitting assembly according to claim 31, further comprising second normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said second valve means when said second fluid conduit is inserted into said socket means.

33. A quick-connect fitting assembly according to claim 24, further comprising a resilient retainer member disposed within said socket means and generally surrounding at least a portion of said removal means and said second fluid conduit; said resilient retainer member having said first, second and third barb members extending generally in a laterally inward direction therefrom.

34. A quick-connect fitting assembly according to claim 24, further comprising lateral support means for laterally supporting said second fluid conduit relative to said socket means generally adjacent the longitudinally inner end of said second fluid conduit.

35. A quick-connect fitting assembly according to claim 34, wherein said lateral support means comprises a reduced diameter portion of said socket means surrounding and



laterally engaging said longitudinally inner end of said second fluid conduit.

36. A quick-connect fitting assembly for connecting a pair of fluid conduits to one another for fluid communication therebetween, said quick-connect fitting assembly comprising:

socket means on a first of the fluid conduits for receiving a second of said fluid conduits inserted longitudinally inwardly into said socket means;

first normally-closed valve means disposed within said socket means for sealingly closing off said first conduit, and means for opening said first valve means when said second fluid conduit is inserted into said socket means; and

second normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said second valve means when said second fluid conduit is inserted into said socket means.

37. A quick-connect fitting assembly according to claim 36, wherein said second fluid conduit has a laterally-extending protuberance thereon, said assembly further including a barb member disposed within said socket means and being resiliently deflectable into a longitudinally interlocking engagement with said protuberance on said second fluid conduit as second fluid conduit is inserted into said socket means.

38. A quick-connect fitting assembly according to claim 37, further comprising removal means longitudinally insertable into said socket means and being selectively movable therein to urge said barb member out of said interlocking engagement with said protuberance on said second fluid conduit.

39. A quick-connect fitting assembly according to claim 38, further comprising a second barb member within said socket means resiliently deflectable into a longitudinally interlocking engagement with said removal means in order to retain said removal means in said socket means when said removal means is inserted therein.

40. A quick-connect fitting assembly according to claim 38, wherein said removal means includes a sleeve member between said second protuberance and said socket means, said sleeve member being slidably movable longitudinally on said second fluid conduit into engagement with said barb member.

41. A quick-connect fitting assembly according to claim 37, further comprising lateral support means for laterally supporting said second fluid conduit relative to said socket means at a longitudinal position outward of said barb member.

42. A quick-connect fitting assembly according to claim 41, further comprising second lateral support means for laterally sup-

porting said second fluid conduit relative to said socket means generally adjacent the longitudinally inner end of said second fluid conduit.

43. A quick connect fitting assembly according to claim 42, wherein said second lateral support means comprises a reduced diameter portion of said socket means surrounding and laterally engaging said longitudinally inner end of said second fluid conduit.

44. A quick-connect fitting assembly for releasably connecting a pair of fluid conduits to one another for fluid communication therebetween, said quick-connect assembly comprising:

socket means on a first of said fluid conduits for receiving a second of said fluid conduits inserted longitudinally inwardly into said socket means;

removal means for selectively withdrawing said second fluid conduit from said socket means in order to disconnect said first and second fluid conduits from one another;

a first valve seat disposed within said socket means, a first valve member longitudinally movable within said socket means between an open position away from said first valve seat and a closed position sealingly engaging said first valve seat in order to sealingly close off fluid communication into or out of said first fluid conduit, and first biasing means for biasing said first valve member into said sealing engagement with said first valve seat;

a second valve seat disposed within said second fluid conduit generally at an end portion thereof, a second valve member longitudinally movable between an open position away from said second valve seat and a closed position sealingly engaging said second valve seat in order to sealingly close off fluid communication into or out of said second fluid conduit, and second biasing means for biasing said second valve member into said sealing engagement with said second valve seat; and

said first and second valve members having respective first and second actuating members extending longitudinally therefrom, said first and second actuating members abutting one another as said second fluid conduit is inserted into said socket means in order to longitudinally urge said first and second valve members away from their respective first and second valve seats and open fluid communication between said first and second fluid conduits when said second fluid conduit is inserted into said socket means, said first and second biasing means urging said respective first and second valve members into their respective closed positions when said second fluid conduit is withdrawn from said socket means.

45. A quick-connect fitting assembly according to claim 44, wherein said second fluid



- conduit has a generally laterally-extending protuberance thereon, said socket means including a barb member disposed therein and being resiliently deflectable into a longitudinal engagement with said protuberance on said second fluid conduit as said second fluid conduit is inserted into said socket means.
46. A quick-connect fitting assembly according to claim 45, wherein said removal means includes a sleeve member disposed between said second fluid conduit and said socket means, said sleeve member being slidably movable longitudinally on said second fluid conduit into engagement with said barb member in order to urge said barb member out of said interlocking engagement with said protuberance and to allow said second fluid conduit to be withdrawn from said socket means.
47. A quick-connect fitting assembly according to claim 46, further including lateral support means for laterally supporting said second fluid conduit relative to said socket means at a longitudinal position outward of said barb member, said lateral support means including a second protuberance on said second fluid conduit extending laterally outwardly in a laterally supporting engagement with said sleeve member.
48. A quick-connect fitting assembly according to claim 47, wherein said lateral support means further includes a collar member in said socket means, said collar member being disposed between said sleeve member and the remainder of said socket means at a longitudinal position generally surrounding said second protuberance on said second fluid conduit.
49. A quick-connect fitting assembly according to claim 48, further comprising second lateral support means for laterally supporting said second fluid conduit relative to said socket means generally adjacent the longitudinally inner end of said second fluid conduit.
50. A quick-connect fitting assembly according to claim 49, wherein said second lateral support means comprises a reduced diameter portion of said socket means surrounding and laterally engaging said longitudinally inner end of said second fluid conduit.
51. A quick-connect fitting assembly for releasably connecting a pair of fluid conduits to one another for fluid communication therebetween, said quick-connect assembly comprising:
- socket means on a first of said fluid conduits for receiving a second of said fluid conduits inserted longitudinally inwardly into said socket means, said second fluid conduit having first and second laterally-extending protuberances longitudinally spaced apart thereon;
  - a resilient retainer member disposed within said socket means and generally surrounding said second fluid conduit when said second fluid conduit is inserted into said socket means, said resilient retainer member having at least three barb members longitudinally spaced thereon and extending generally laterally therefrom, a first of said barb members being resiliently deflectable into a longitudinally interlocking engagement with said first protuberance on said second fluid conduit as said second fluid conduit is inserted into said socket means in order to retain said second fluid conduit therein;
  - a removal sleeve member disposed within said socket means between said second protuberance on said second fluid conduit and said socket means, said removal sleeve being slidably movable longitudinally on said second fluid conduit into engagement with said barb member in order to urge said first barb member out of said interlocking engagement with said first protuberance on said second fluid conduit and to allow said second fluid conduit to be withdrawn from said socket means, said removal sleeve member having a discontinuity thereon, a second of said barb members being resiliently deflectable into a longitudinal engagement with said discontinuity for retaining said removal sleeve within said socket means but allowing said longitudinal movement therein;
  - a collar member disposed within said socket means between said removal sleeve member and the remainder of said socket means at a longitudinal position generally surrounding said second protuberance on said second fluid conduit in order to laterally support said second fluid conduit at said longitudinal position, said collar member being longitudinally and interlockingly engaged by a third of said barb members in order to retain said collar member within said socket means;
  - a first valve seat disposed within said socket means, a first valve member longitudinally movable within said socket means between an open position away from said first valve seat and a closed position sealingly engaging said first valve seat in order to sealingly close off fluid communication into or out of said first fluid conduit, and first biasing means for biasing said first valve member into said sealing engagement with said first valve seat;
  - a second valve seat disposed within said second fluid conduit generally at an end portion thereof, a second valve member longitudinally movable between an open position away from said second valve seat and a closed position sealingly engaging said second valve seat in order to sealingly close off fluid communication into or out of said second fluid conduit, and second biasing means for biasing said second valve member into said sealing engagement with said

second valve seat; and  
 said first and second valve members having  
 respective first and second actuating mem-  
 bers extending longitudinally therefrom, said  
 5 first and second actuating members abutting  
 one another as said second fluid conduit is  
 inserted into said socket means in order to  
 longitudinally urge said first and second  
 10 valve members away from their respective  
 first and second valve seats and open fluid  
 communication between said first and sec-  
 ond fluid conduits when said second fluid  
 conduit is inserted into said socket means,  
 15 said first and second biasing means urging  
 said respective first and second valve mem-  
 bers into their respective closed positions  
 when said second fluid conduit is withdrawn  
 from said socket means.

52. A quick-connect fitting assembly ac-  
 20 cording to claim 51, further comprising at  
 least one second collar member disposed  
 within said socket means between said sec-  
 ond fluid conduit and said socket means at a  
 second longitudinal position generally adjacent  
 25 said first protuberance on said second fluid  
 conduit in order to laterally support said sec-  
 ond fluid conduit at said second longitudinal  
 position, said second collar member being  
 longitudinally abutted by said resilient retainer  
 30 in order to retain said second collar member  
 within said socket means.

53. A quick-connect fitting assembly ac-  
 cording to claim 52, further including sealing  
 means disposed within said socket means and  
 35 in sealing engagement between said second  
 fluid conduit and said socket means.

54. A quick-connect fitting assembly for  
 releasably connecting a pair of fluid conduits  
 to one another for fluid communication there-  
 40 between, said quick-connect fitting assembly  
 comprising:

socket means on a first of the fluid conduits  
 for receiving a second of said fluid conduits  
 inserted longitudinally inwardly into said  
 45 socket means, said second fluid conduit  
 having a laterally-extending protuberance  
 thereon;

retainer means for releasably retaining said  
 second fluid conduit within said socket  
 50 means, said retainer means including a barb  
 member disposed within said socket means  
 and being resiliently deflectable into a longi-  
 tudinally interlocking engagement with said  
 protuberance as said second fluid conduit is  
 55 inserted into said socket means;

removal means longitudinally insertable into  
 said socket means and being selectively  
 movable longitudinally inwardly therein to  
 urge said barb member out of said interlock-  
 60 ing engagement with said protuberance; and  
 a removal means barb member fixed on said  
 removal means and being resiliently deflec-  
 table into a longitudinal engagement with a  
 portion of said socket means as said re-  
 65 moval means is inserted into said socket

means, said removal means barb member  
 limiting the longitudinally outward movement  
 of said removal means in said socket means  
 while allowing said longitudinally inward  
 70 movement therein.

55. A quick-connect fitting assembly ac-  
 cording to claim 54, wherein said removal  
 means barb member protrudes in a generally  
 laterally and longitudinally outward direction  
 75 from the remainder of said removal means.

56. A quick-connect fitting assembly ac-  
 cording to claim 54, further comprising means  
 associated with said removal means for sub-  
 stantially preventing foreign material from en-  
 80 tering said socket means when said second  
 fluid conduit is inserted into said socket  
 means.

57. A quick-connect fitting assembly ac-  
 cording to claim 54, further comprising lateral  
 85 support means for laterally supporting said  
 second fluid conduit relative to said socket  
 means at a longitudinal position outward of  
 said barb member.

58. A quick-connect fitting assembly ac-  
 90 cording to claim 57, wherein said lateral sup-  
 port means includes a second protuberance on  
 said second fluid conduit extending laterally  
 outwardly in a laterally supporting engagement  
 with said removal means.

59. A quick-connect fitting assembly ac-  
 95 cording to claim 58, wherein said lateral sup-  
 port means further includes a collar member in  
 said socket means, said collar member being  
 disposed between said removal means and  
 100 the remainder of said socket means at a longi-  
 tudinal location generally surrounding said sec-  
 ond protuberance with said removal means  
 therebetween.

60. A quick-connect fitting assembly ac-  
 105 cording to claim 54, wherein said removal  
 means includes a sleeve member disposed be-  
 tween said second protuberance and said  
 socket means, said sleeve member being sli-  
 dably movable in a generally inward longitu-  
 110 dinal direction on said second fluid conduit into  
 engagement with said barb member.

61. A quick-connect fitting assembly ac-  
 cording to claim 54, further comprising nor-  
 mally-closed valve means on said second fluid  
 conduit for sealingly closing off said second  
 115 fluid conduit, and means for opening said  
 valve means when said second fluid conduit is  
 inserted into said socket means.

62. A quick-connect fitting assembly ac-  
 120 cording to claim 54, further comprising nor-  
 mally-closed valve means disposed within said  
 socket means for sealingly closing off said  
 first fluid conduit, and means for opening said  
 valve means when said second fluid conduit is  
 125 inserted into said socket means.

63. A quick-connect fitting assembly ac-  
 cording to claim 62, further comprising sec-  
 ond normally-closed valve means on said sec-  
 ond fluid conduit for sealingly closing off said  
 130 second fluid conduit, and means for opening

said second valve means when said second fluid conduit is inserted into said socket means.

64. A quick-connect fitting assembly according to claim 57, further comprising second lateral means for laterally supporting said second fluid conduit relative to said socket means generally adjacent the longitudinally inner end of said second fluid conduit.

65. A quick-connect fitting assembly according to claim 64, wherein said second lateral support means comprises a reduced diameter portion of said socket means surrounding and laterally engaging said longitudinally inner end of said second fluid conduit.

66. A quick-connect fitting assembly for releasably connecting a pair of fluid conduits to one another for fluid communication therebetween, said quick-connect fitting assembly comprising:

socket means on a first of the fluid conduits for receiving a second of said fluid conduits inserted longitudinally inwardly into said socket means, said second fluid conduit having a laterally-extending protuberance thereon;

retainer means for releasably retaining said second fluid conduit within said socket means, said retainer means including a barb member disposed within said socket means and being resiliently deflectable into a longitudinally interlocking engagement with said protuberance as said second fluid conduit is inserted into said socket means; and

removal means for engaging and deflectably urging said barb member out of said interlocking engagement with said protuberance in order to allow said second fluid conduit to be removed from said socket means,

said removal means including a sleeve member disposed between said second fluid conduit and said socket means at a longitudinal position substantially wholly within said socket means, said sleeve member being longitudinally movable within said socket means in a generally inward direction into said engagement with said barb member.

67. A quick-connect fitting assembly according to claim 66, further comprising means associated with said removal means for substantially preventing foreign material from entering said socket means when said second fluid conduit is inserted into said socket means.

68. A quick-connect fitting assembly according to claim 66, further comprising lateral support means for laterally supporting said second fluid conduit relative to said socket means at a longitudinal position outward of said barb member.

69. A quick-connect fitting assembly according to claim 66, wherein said sleeve member includes a generally laterally-extending flange portion thereon, said socket means including a laterally inwardly-extending portion

engageable by said flange portion for retaining said sleeve member within said socket means and for limiting the longitudinal outward movement of said sleeve member within said socket means.

70. A quick-connect fitting assembly according to claim 69, further comprising lateral support means for laterally supporting said second fluid conduit relative to said socket means at a longitudinal position outward of said barb member, said lateral support means including a second protuberance on said second fluid conduit extending laterally outwardly in a laterally supporting engagement with said sleeve member generally at a longitudinal position wherein said flange portion is laterally between said second protuberance and said socket means.

71. A quick-connect fitting assembly according to claim 69, further comprising a second barb member within said socket means resiliently deflectable into a longitudinally interlocking engagement with said flange portion in order to further retain said sleeve member in said socket means.

72. A quick-connect fitting assembly according to claim 66, further comprising normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.

73. A quick-connect fitting assembly according to claim 66, further comprising normally-closed valve means disposed within said socket means for sealingly closing off said first fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.

74. A quick-connect fitting assembly according to claim 73, further comprising second normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said second valve means when said second fluid conduit is inserted into said socket means.

75. A quick-connect fitting assembly according to claim 66, further comprising tool means removably insertable into said socket means for abutably engaging said sleeve member in order to longitudinally move said sleeve member inwardly within said socket means into said engagement with said barb member.

76. A quick-connect fitting assembly according to claim 75, wherein said tool means comprises a generally U-shaped tool member adapted to be slidably received on said second fluid conduit at a position longitudinally outward of said socket means for longitudinal slidable movement thereon, a portion of said U-shaped tool member being insertable into said socket means in said abutting engagement with said sleeve member when said tool

member is slidably moved in a longitudinally inward direction on said second fluid conduit.

77. A quick-connect fitting assembly according to claim 66, further comprising second lateral support means for laterally supporting said second fluid conduit relative to said socket means generally adjacent the longitudinally inner end of said second fluid conduit.

78. A quick-connect fitting assembly according to claim 77, wherein said second lateral support means comprises a reduced diameter portion of said socket means surrounding and laterally engaging said longitudinally inner end of said second fluid conduit.

79. A quick-connect fitting assembly for releasably connecting a pair of fluid conduits to one another for fluid communication therebetween, said quick-connect fitting assembly comprising:

socket means on a first of the fluid conduits for receiving a second of said fluid conduits inserted longitudinally inwardly into said socket means, said second fluid conduit having a laterally-extending protuberance thereon;

a number of barb members disposed within said socket means and being resiliently deflectable into a longitudinally interlocking engagement with said protuberance as said second fluid conduit is inserted into said socket means; and

removal means for engaging and deflectably urging said barb members out of said interlocking engagement with said protuberance in order to allow said second fluid conduit to be removed from said socket means, said removal means including a sleeve member disposed between said second fluid conduit and said socket means at a longitudinal position substantially wholly within said socket means, said sleeve member being longitudinally movable within said socket means in a generally inward direction into said engagement with said barb members, said sleeve member including an annular barb member extending generally laterally outwardly therefrom for engaging a portion of said socket means for retaining said sleeve member within said socket means and for limiting the longitudinal outward movement of said sleeve member within said socket member.

80. A quick-connect fitting assembly according to claim 79, wherein said socket means includes a generally cylindrical outer portion and a generally cylindrical inner portion disposed substantially concentrically within said outer portion, said second fluid conduit being received within said outer portion and said inner portion being received within said second fluid conduit when said second fluid conduit is inserted into said socket means.

81. A quick-connect fitting assembly ac-

cording to claim 79, further comprising means associated with said removal means for substantially preventing foreign material from entering said socket means when said second fluid conduit is inserted into said socket means.

82. A quick-connect fitting assembly according to claim 79, wherein said socket means includes a number of internal slots therein, each of said barb members being received within one of said internal slots.

83. A quick-connect fitting assembly according to claim 82, wherein said socket means includes a collar member therein between said sleeve member and said internal slots, said collar member retaining said barb members in their associated internal slots.

84. A quick-connect fitting assembly according to claim 79, further comprising lateral support means for laterally supporting said second fluid conduit relative to said socket means.

85. A quick-connect fitting assembly according to claim 84, wherein said lateral support means includes a second protuberance on said second fluid conduit extending laterally outwardly in a laterally supporting engagement with said removal means.

86. A quick-connect fitting assembly according to claim 85, wherein said socket means includes a collar member disposed between said sleeve member and the remainder of said socket means at a longitudinal location generally surrounding said second protuberance with said sleeve member therebetween in order to laterally support said second fluid conduit relative to said socket means.

87. A quick-connect fitting assembly according to claim 86, wherein said socket means includes a generally cylindrical outer portion and a generally cylindrical inner portion disposed substantially concentrically within a portion of said outer portion, said second fluid conduit being received with said outer portion and said inner portion being received within said second fluid conduit when second fluid conduit is inserted into said socket means in order to further laterally support said second fluid conduit relative to said socket means.

88. A quick-connect fitting assembly according to claim 79, further comprising normally-closed valve means on said second fluid conduit for sealingly closing off said second fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.

89. A quick-connect fitting assembly according to claim 79, further comprising normally-closed valve means disposed within said socket means for sealingly closing off said first fluid conduit, and means for opening said valve means when said second fluid conduit is inserted into said socket means.

90. A quick-connect fitting assembly according to claim 89, further comprising second normally-closed valve means on said second fluid conduit for sealingly closing off  
5 said second fluid conduit, and means for opening said second valve means when said second fluid conduit is inserted into said socket means.

91. A quick-connect fitting assembly according to claim 79, wherein said tool  
10 means comprises a generally U-shaped tool member adapted to be slidably received on said second fluid conduit at a position longitudinally outward of said socket means for  
15 longitudinal slidable movement thereon, a portion of said U-shaped tool member being insertable into said socket means in said abutting engagement with said sleeve member when said tool member is slidably  
20 moved in a longitudinally inward direction on said second fluid conduit.

92. A quick-connect fitting assembly constructed and arranged to operate substantially as herein described with reference  
25 to and as illustrated in the accompanying drawings.